EPA – MPCA – POLYMET MEETING

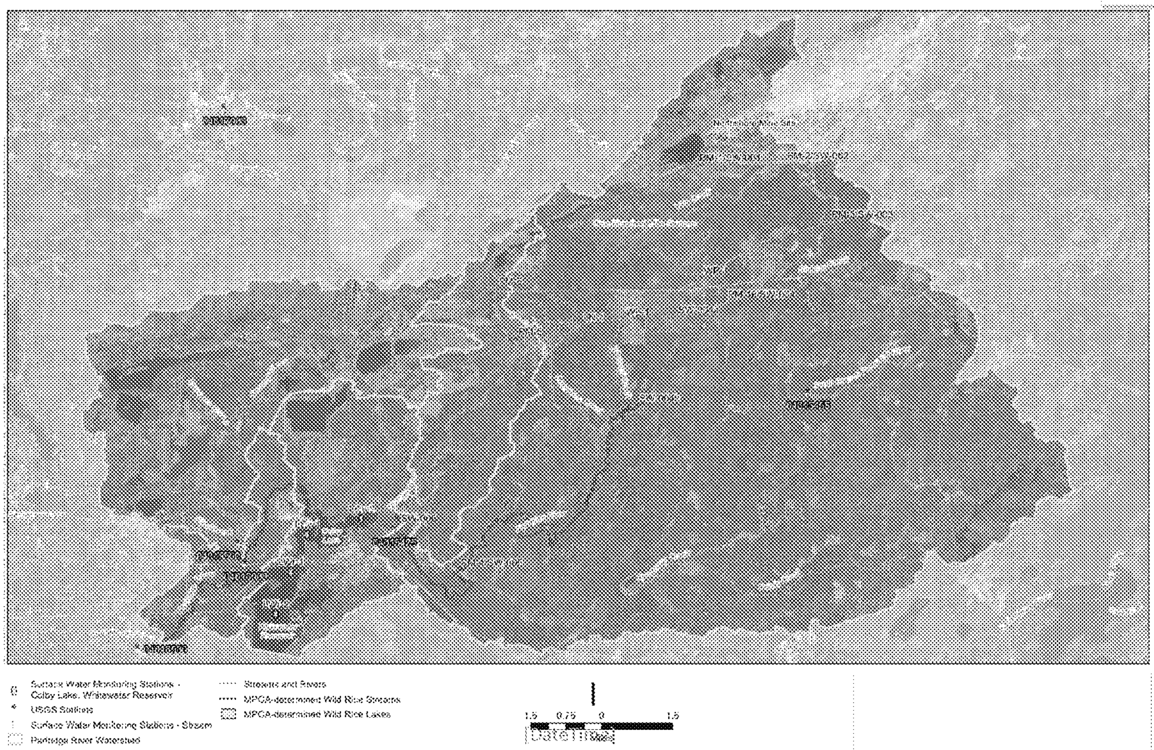
July 12, 2012

MPCA Office – St. Paul

AGENDA

1. Introductions and Goal of Meeting
2. Mine Site
3. Probabilistic Model Outputs
4. IAP Impact Criteria Process
5. Protecting Existing Surface Water Quality
6. Tribal Standards
7. Follow-up Items from This Meeting
8. Next Meeting Topic
   - Wild Rice

Partridge River Surface Water Monitoring Locations

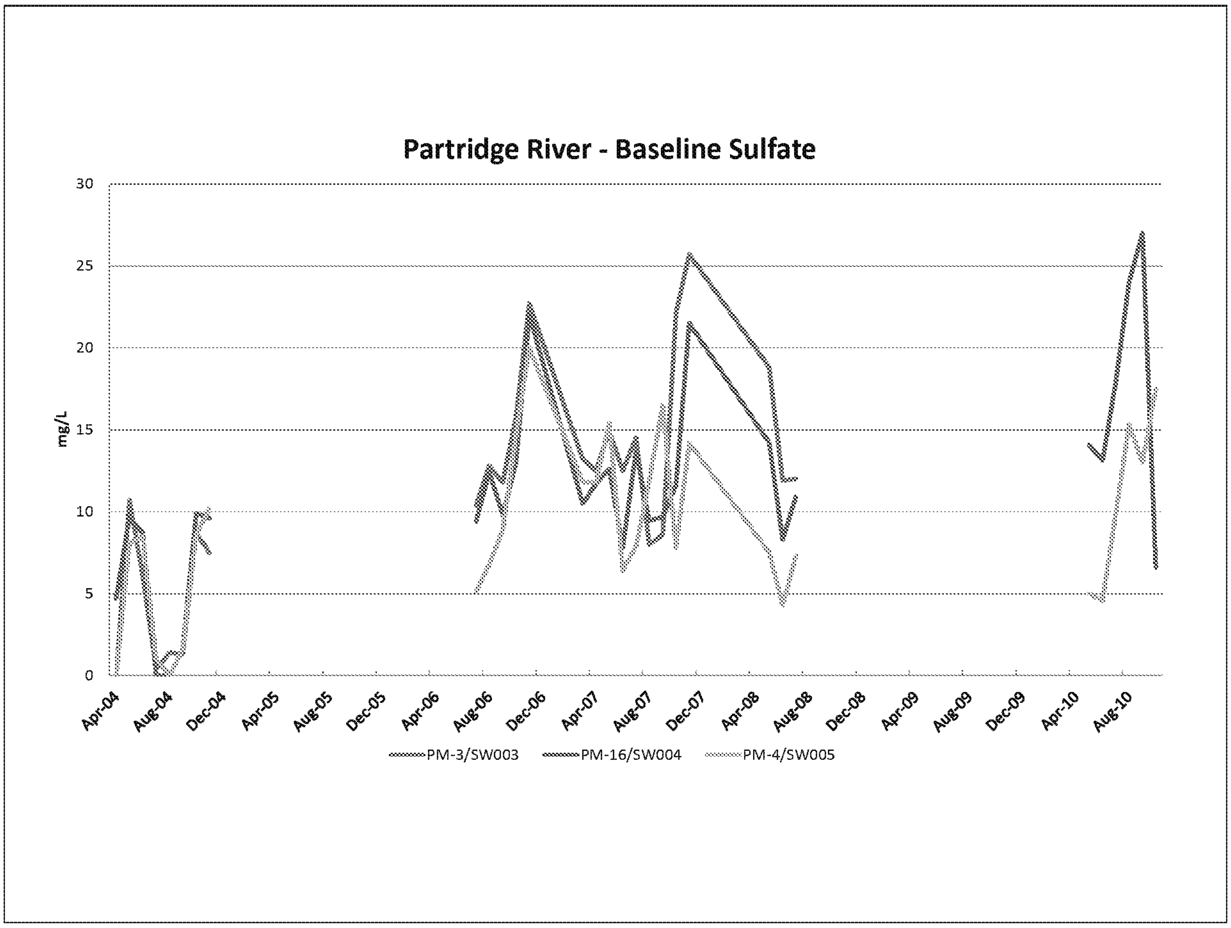


Partridge River Surface Water Monitoring Locations

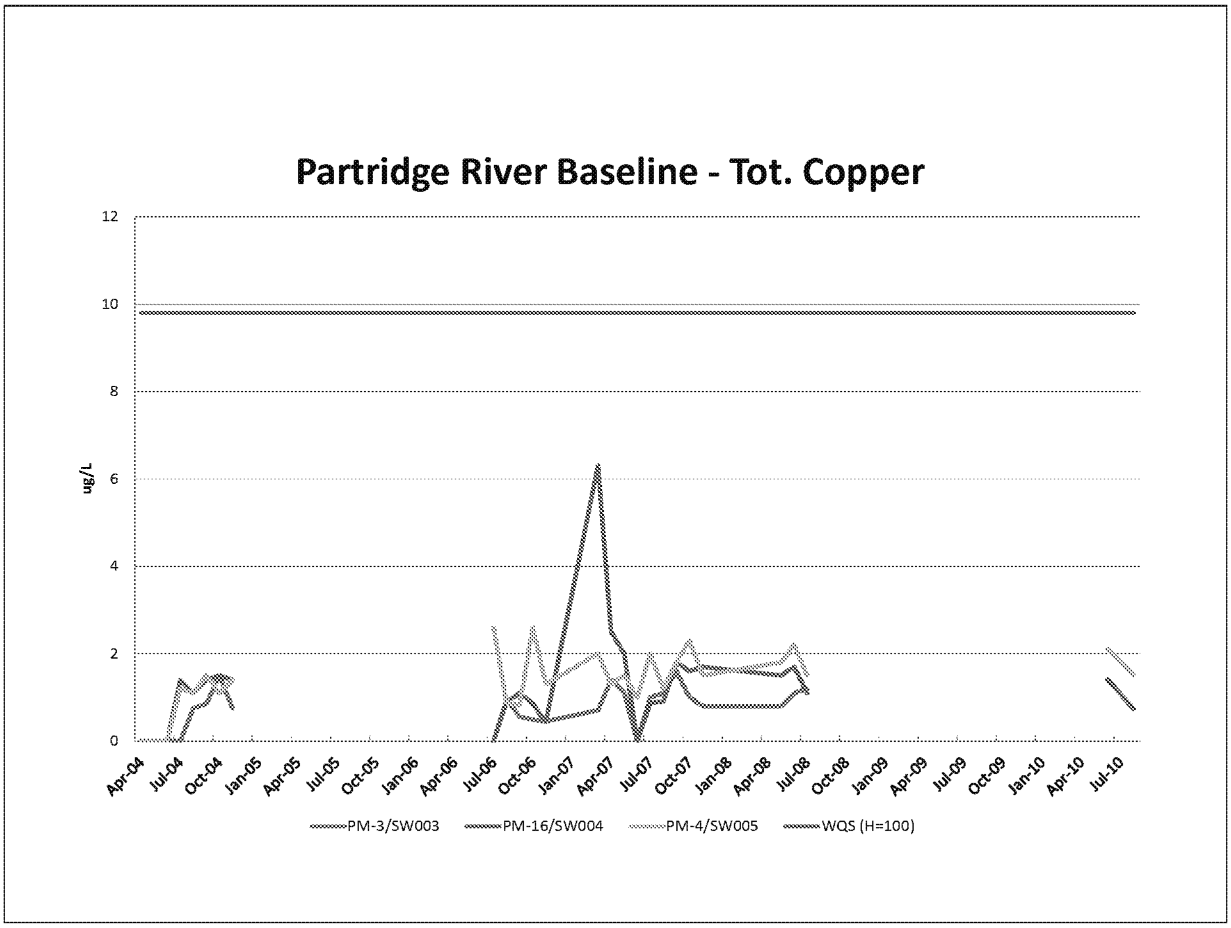
- PM-1 / SW001
  Headwaters / Northshore Mining Discharge
- PM-2 / SW002
  Upstream of all PolyMet Mine Site influences
- PM-3 / SW003
  Dunka Rd / Upstream of all PolyMet influences
- PM-16 / SW004
  Downstream of most, but not all of PolyMet influences
- SW004a
  Downstream of all PolyMet Mine Site influences
- PM-4 / SW005
  Downstream, above Colby Lake

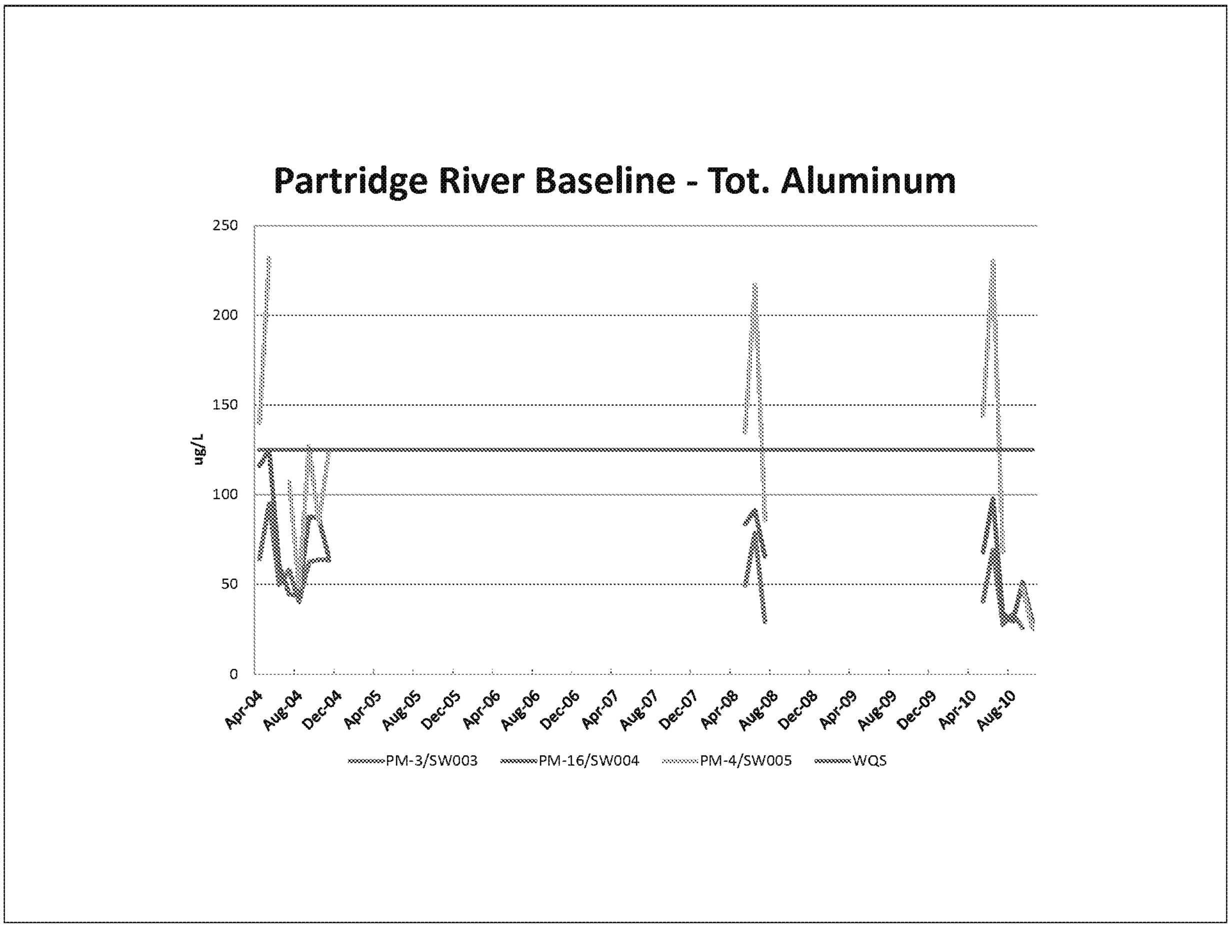
Partridge River Existing Water Quality

- Sulfate generally between 5 and 25 mg/L
  - Generally higher upstream vs downstream
  - Somewhat dependent on Northshore activities
- Copper generally less than 2 ug/L
  - Well under applicable WQS (as are most parameters)
- Baseline for some parameters may sometimes be above WQS
  - Example: Total aluminum



Partridge River - Baseline Sulfate
mg/L
30
25
20
15
10
5
0
Apr-04
Aug-04
Dec-04
Apr-05
Aug-05
Dec-05
Apr-06
Aug-06
Dec-06
Apr-07
Aug-07
Dec-07
Apr-08
Aug-08
Dec-08
Apr-09
Aug-09
Dec-09
Apr-10
Aug-10
PM-3/SW003
PM-16/SW004
PM-4/SW005


Partridge River Baseline - Tot. Copper
12
10
8
6
4
2
0
ug/L
Apr-04
Jul-04
Oct-04
Jan-05
Apr-05
Jul-05
Oct-05
Jan-06
Apr-06
Jul-06
Oct-06
Jan-07
Apr-07
Jul-07
Oct-07
Jan-08
Apr-08
Jul-08
Oct-08
Jan-09
Apr-09
Jul-09
Oct-09
Jan-10
Apr-10
Jul-10
PM-3/SW003
PM-16/SW004
PM-4/SW005
WQS (H=100)

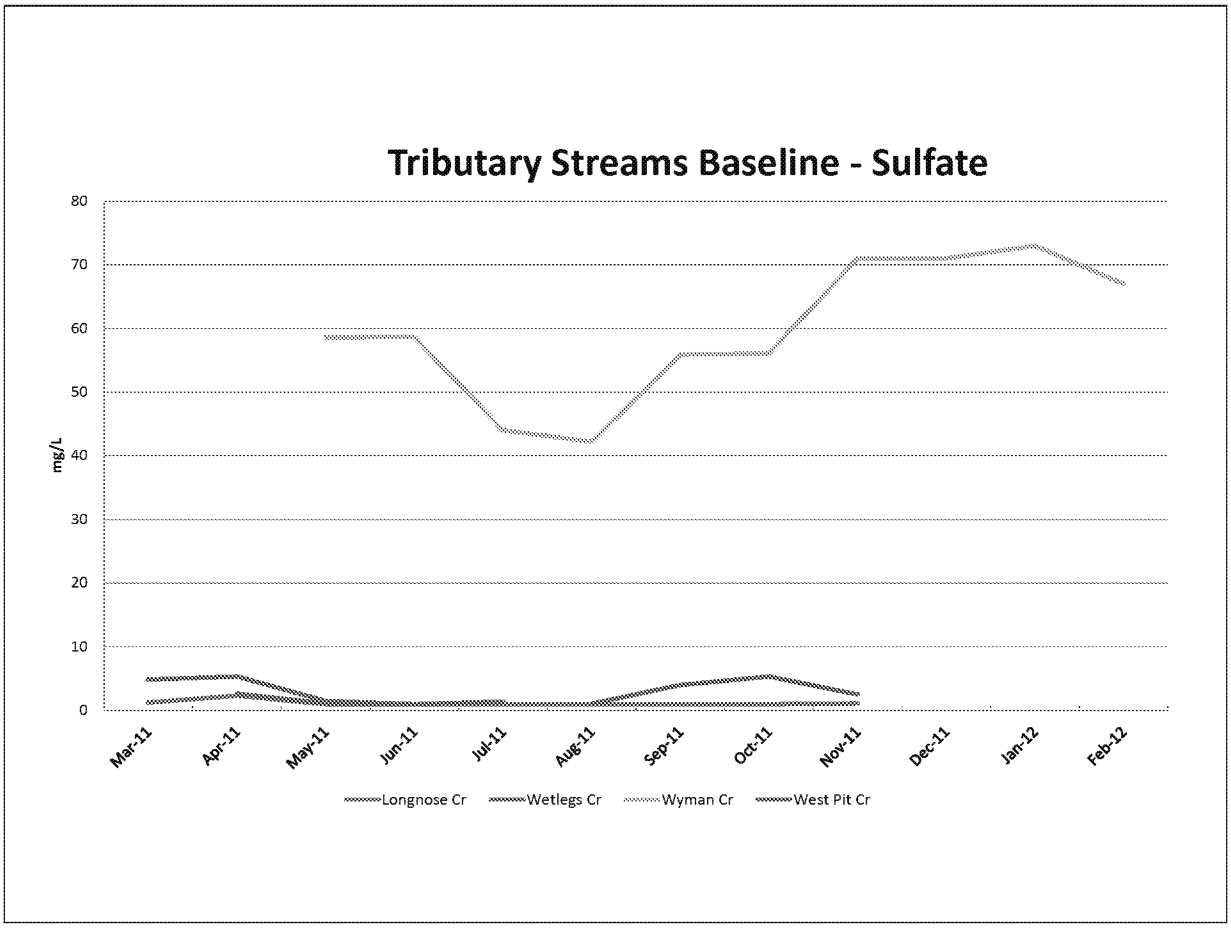

Partridge River Baseline - Tot. Aluminum
250
200
150
100
50
0
ug/L
Apr-04
Aug-04
Dec-04
Apr-05
Aug-05
Dec-05
Apr-06
Aug-06
Dec-06
Apr-07
Aug-07
Dec-07
Apr-08
Aug-08
Dec-08
Apr-09
Aug-09
Dec-09
Apr-10
Aug-10
PM-3/SW003
PM-16/SW004
PM-4/SW005
WQS

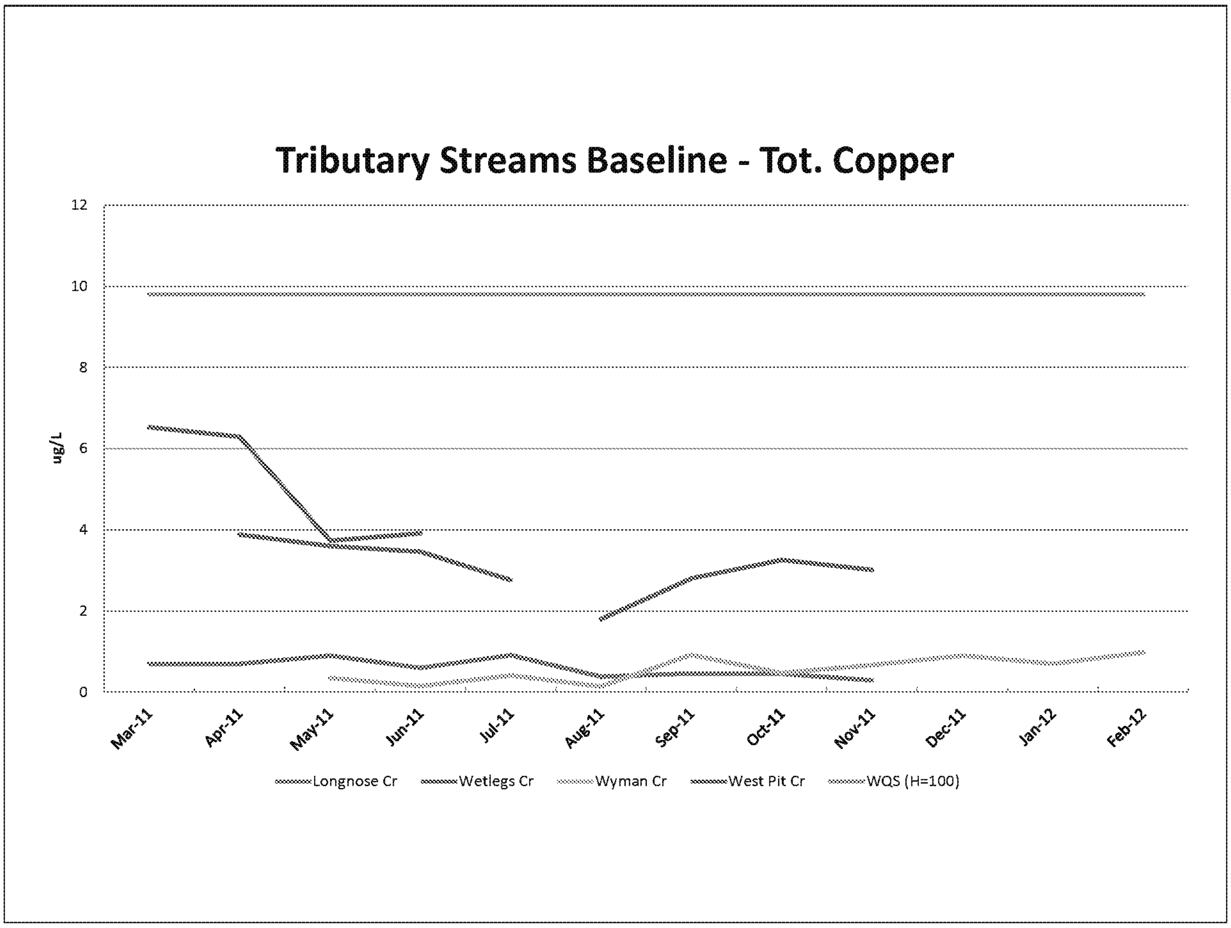
Partridge River Tributary Monitoring Locations

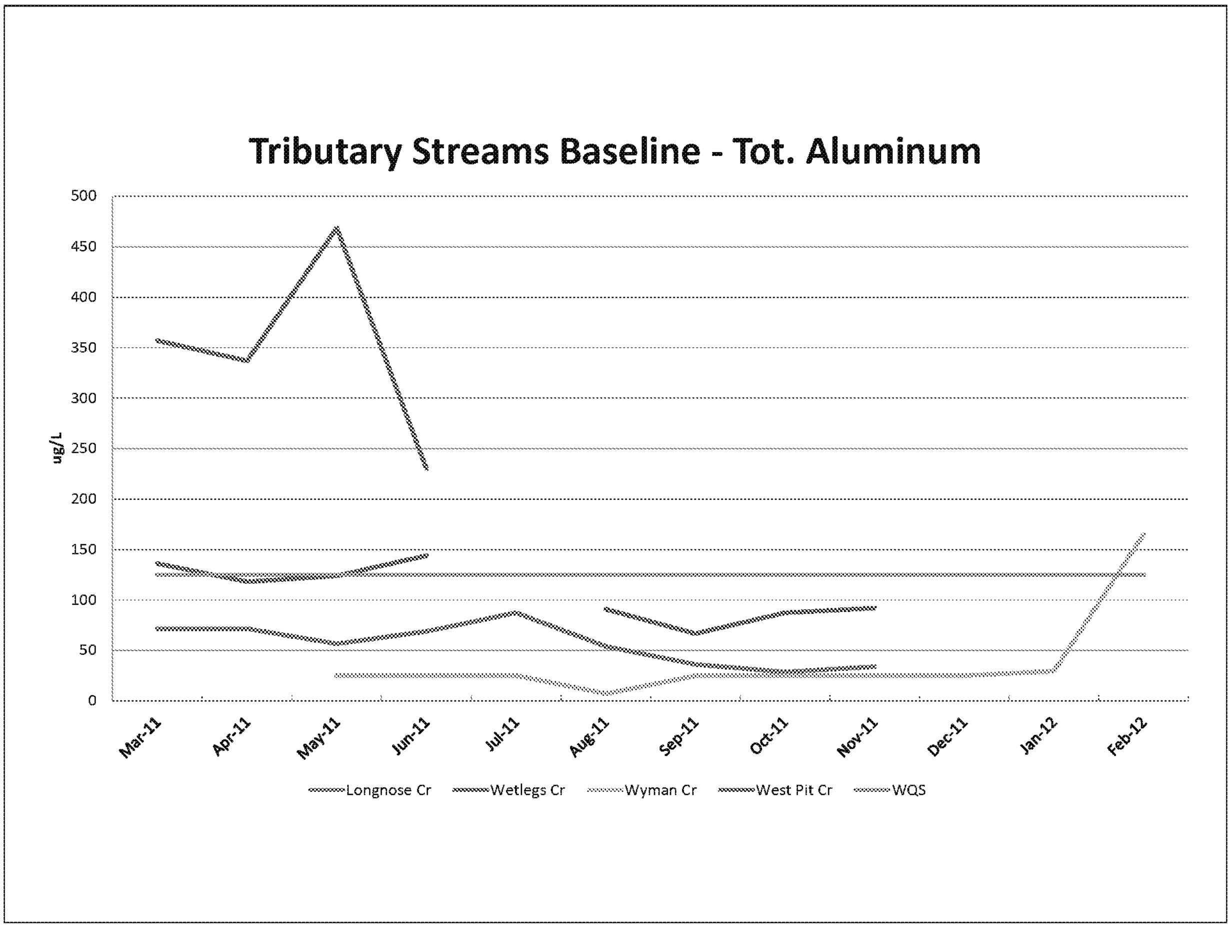
- Wyman Creek
  - PM-5 (upstream of RR)
  - PM-6 (downstream of RR)
- Longnose Creek
  - LN-1 (downstream of RR)
- Wetlegs Creek
  - WL-1 (downstream of RR)
- 'West Pit Creek'
  - WP-1 (downstream of RR)

Tributary Streams Existing Water Quality

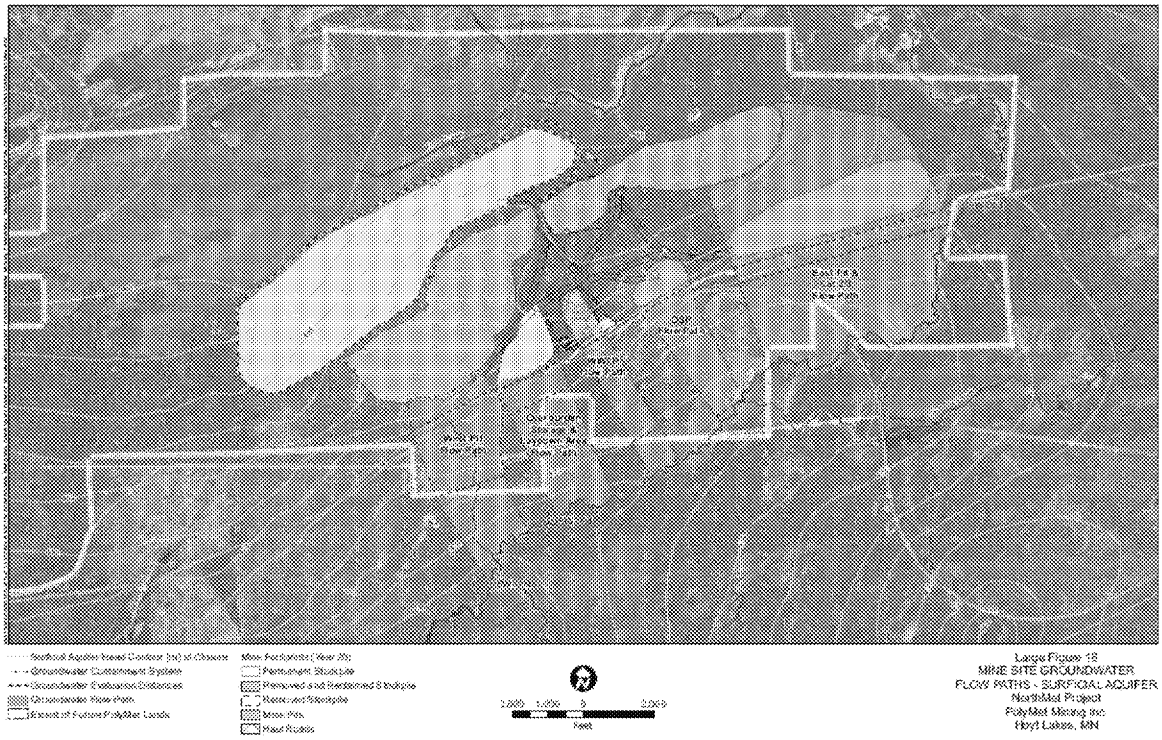
- Sulfate less than 10 mg/L
  - Except Wyman Creek (discharge from former LTV pits)
- Copper under applicable WQS (as are most parameters), but variable
  - Under 2 ug/L for Longnose and Wyman Creeks
  - Higher (3-6 ug/L) for Wetlegs and West Pit Creeks (mineralized bedrock)
- Baseline for some parameters may sometimes be above WQS
  - Example: Total aluminum


Tributary Streams Baseline - Sulfate
mg/L
80
70
60
50
40
30
20
10
0
Mar-11
Apr-11
May-11
Jun-11
Jul-11
Aug-11
Sep-11
Oct-11
Nov-11
Dec-11
Jan-12
Feb-12
Longnose Cr
Wetlegs Cr
Wyman Cr
West Pit Cr

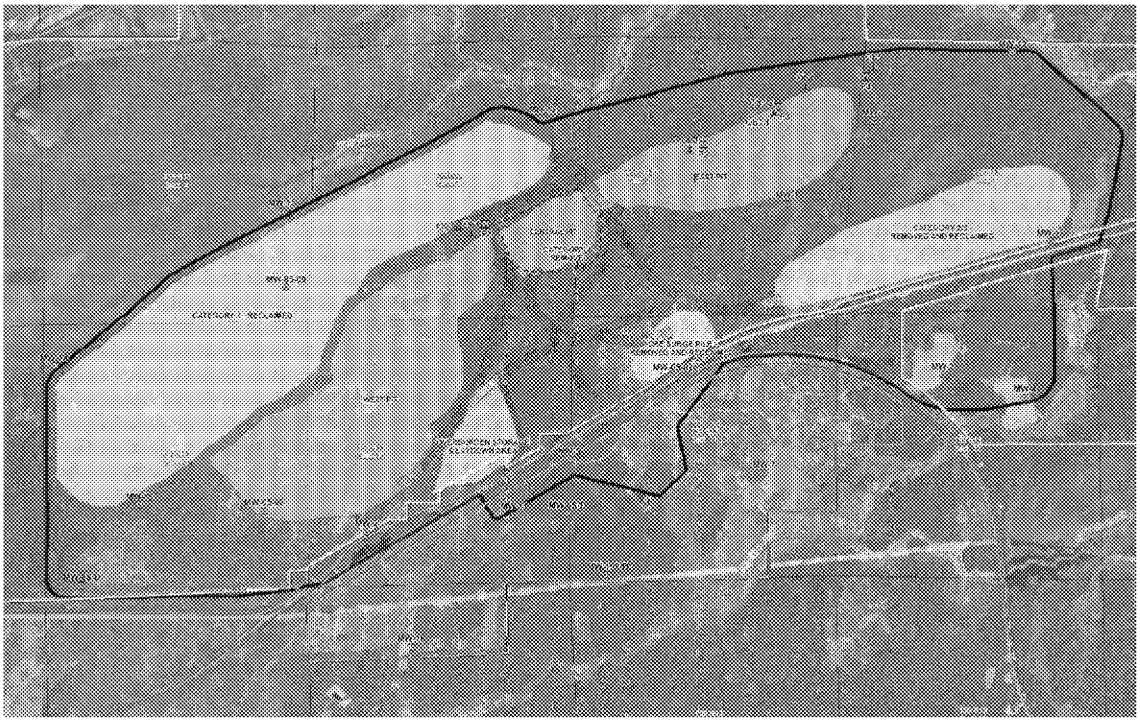

Tributary Streams Baseline - Tot. Copper
ug/L
12
10
8
6
4
2
0
Mar-11
Apr-11
May-11
Jun-11
Jul-11
Aug-11
Sep-11
Oct-11
Nov-11
Dec-11
Jan-12
Feb-12
Longnose Cr
Wetlegs Cr
Wyman Cr
West Pit Cr
WQS (H=100)


Tributary Streams Baseline - Tot. Aluminum
ug/L
500
450
400
350
300
250
200
150
100
50
0
Mar-11
Apr-11
May-11
Jun-11
Jul-11
Aug-11
Sep-11
Oct-11
Nov-11
Dec-11
Jan-12
Feb-12
Longnose Cr
Wetlegs Cr
Wyman Cr
West Pit Cr
WQS

Mine Site Groundwater Flow Paths

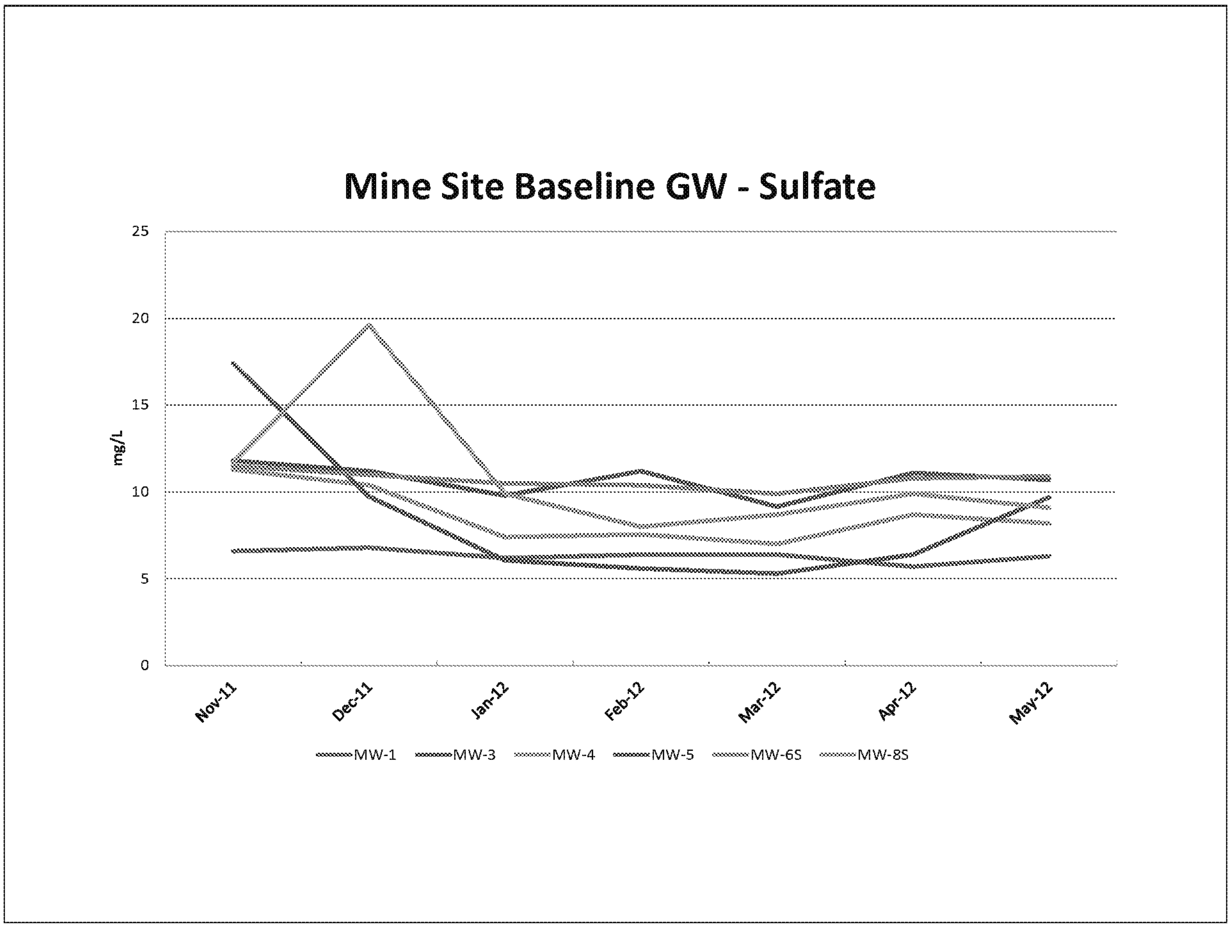


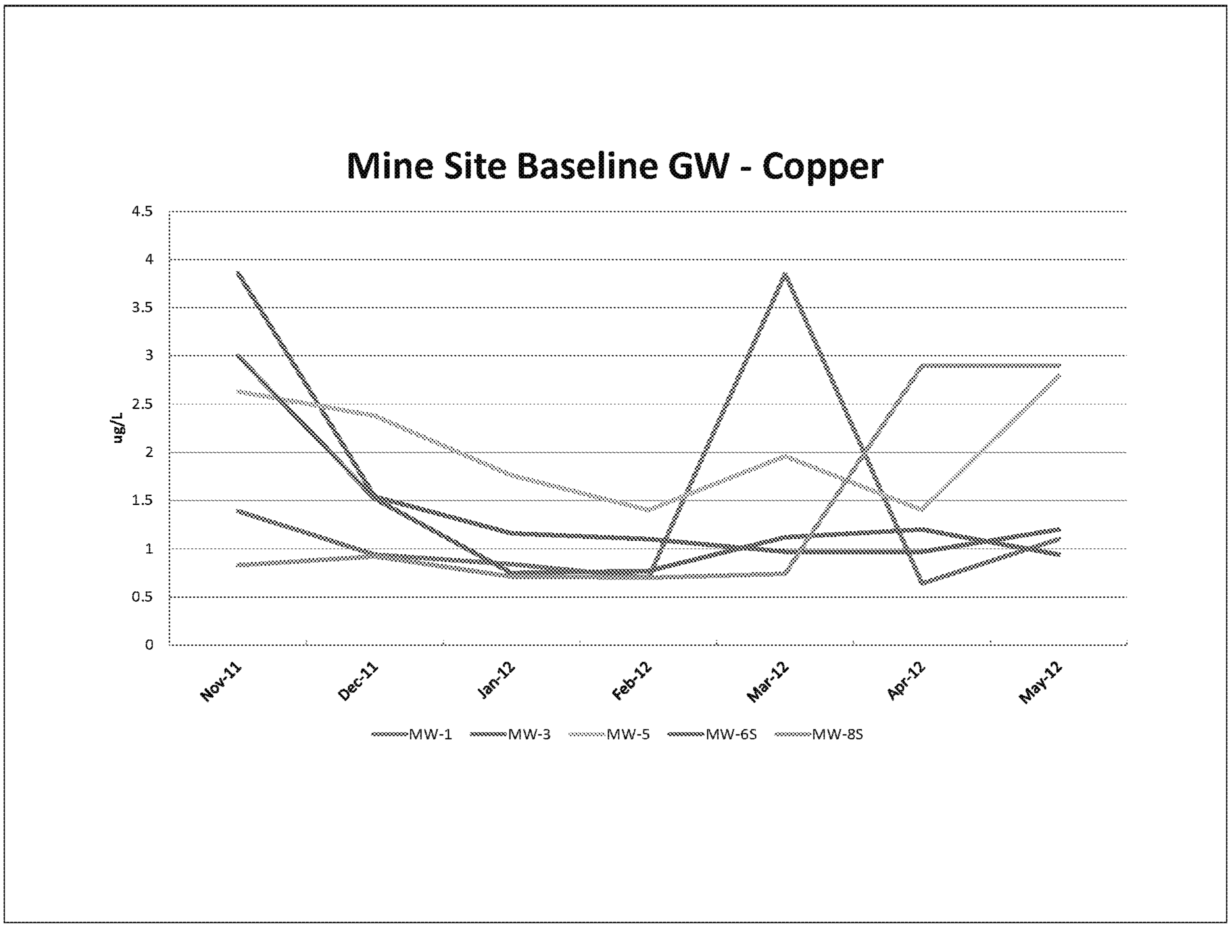
Mine Site Monitoring Wells



Groundwater Existing Water Quality

- 24 Monitoring Wells at Mine Site
- Sulfate generally between 5 and 10 mg/L
  - Not a lot of variability between most wells
- Copper somewhat more variable, but generally below 3 ug/L
- Some parameters may be above applicable groundwater standards
  - Example: Beryllium (complicated by detection limit issue)


Mine Site Baseline GW - Sulfate
25
20
15
10
5
0
mg/L
Nov-11
Dec-11
Jan-12
Feb-12
Mar-12
Apr-12
May-12
MW-1
MW-3
MW-4
MW-5
MW-6S
MW-8S


Mine Site Baseline GW - Copper
4.5
4
3.5
3
2.5
2
1.5
1
0.5
0
ug/L
Nov-11
Dec-11
Jan-12
Feb-12
Mar-12
Apr-12
May-12
MW-1
MW-3
MW-5
MW-6S
MW-8S

Probabilistic Simulations

- **Deterministic Simulation** – no quantification of uncertainty, all input parameters represented as single values (often "best guess" or "worst case")
- **Probabilistic Simulation** – uncertain or variable parameters represented as probability distributions

Probabilistic simulations include explicit representation of the uncertainty in the model parameters, events, and processes.

Variability vs Uncertainty

- **Variability** – Variation over time or space, cannot be described with a single value (ex. annual precipitation depth)

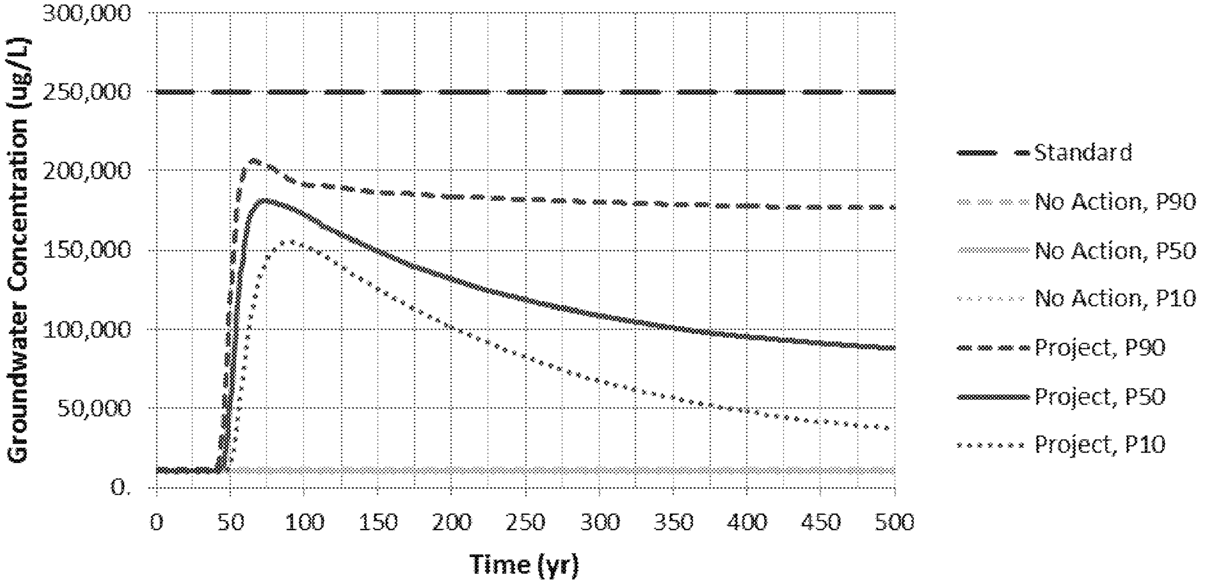
- **Uncertainty** – True value (or process) unknown to some degree (ex. long-term average annual precipitation depth); *does not equate to "error"*

Monte Carlo Analysis

- Model inputs defined using probability distributions
- Model run a large number of times, pulling a unique value from each input probability distribution
- Each model realization represents one equally-likely possible outcome
- Results of all the model realizations assembled into probability distributions of the possible model outcomes

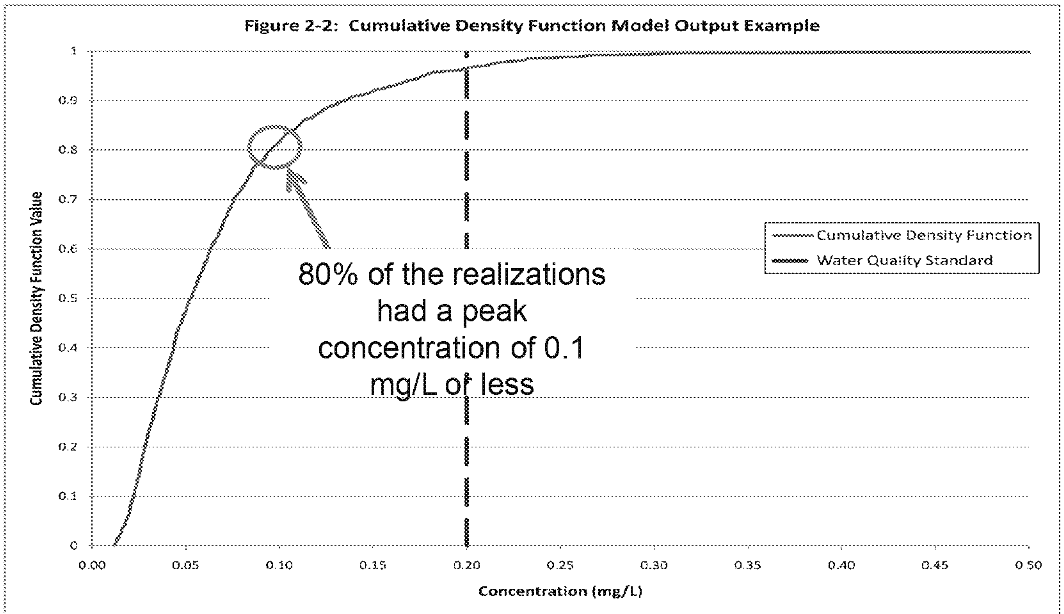
For the NorthMet EIS, we are using one form of probabilistic modeling, referred to as Monte Carlo analysis. For this method, the model is run a large number of times. Each individual simulation represents one equally-likely possible outcome.

Example Output – GW Concentrations Through Time

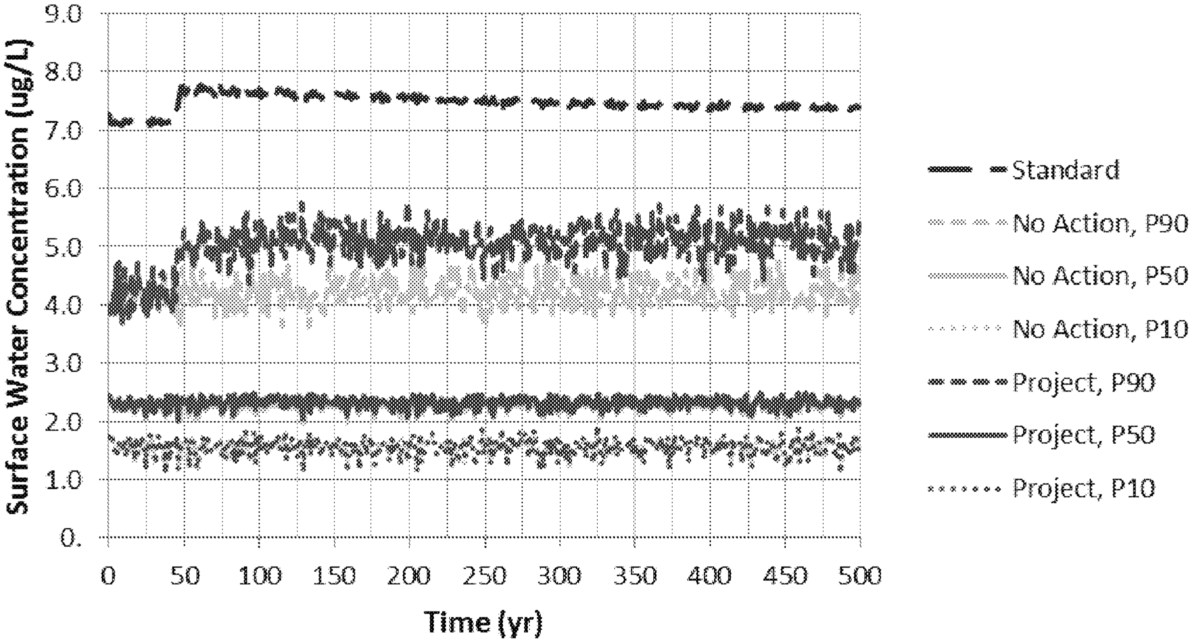


No Action can be thought of as modeled existing conditions
"Project" represents PolyMet's Proposed Action
P90 is the 90th percentile concentrations through time. For example, at year 500, 90% of the model realizations had a concentration of 180 mg/L or less. 50% of the realizations had a concentration of 95 mg/L or less.

Example Output – CDF of Peak Concentrations



Example Output – SW Concentration Through Time



Impact Assessment Planning (IAP) Process

- Part of SDEIS Process
- Involved all participating parties
  - Co Leads (MDNR, USCOE, USFS)
  - Cooperating Agencies (EPA, Tribes)
  - MPCA
- Summary Memos Documenting Decisions
  - Groundwater (June 30, 2011)
  - Surface Water (June 30, 2011)
  - Impact Criteria (Oct. 17, 2011
    - Inc. Oct 17, 2011 'Proposed Approach to Interpreting Probabilistic Modeling Results' Memo

Water Resources/Impact Criteria IAP

Proposed Approach to Interpreting Probabilistic Model Results (10/17/11)

PolyMet is using a probabilistic model (GoldSim) to estimate potential impacts on water quality in support of the NorthMet Project EIS. This modeling approach provides a framework that allows many of the experts on the project review team to incorporate disparate opinions into a single quantitative tool. But this approach produces uncertainty in predicted concentrations of pollutants in surface and groundwater affected by the Project, reported by the model as probability distributions.

NEPA requires that the EIS identify "significant" impacts to water quality (CEQ 1978). As discussed below, comparison of predicted impacts relative to the impact criteria may be used to determine the need for additional mitigation measures in the EIS and/or in permitting. The NorthMet Project SDEIS will use a predicted violation of Federal or State water quality standards as the primary "Significance Criteria." The SDEIS will thus require selecting a specific threshold from the model results (e.g., xth percentile model result, indicating that there is x percent probability that the actual concentration would be below this prediction assuming no additional mitigation, or conversely, there is a 1-x percent probability that the actual concentration would be above this prediction).

1. Impact Criteria

For interpreting model results, the NorthMet project will be assumed to predict a significant effect on water quality if the 90th-percentile model concentration of a solute exceeds the State of Minnesota surface or ground water quality at an evaluation point. Thus if the modeled 90th percentile value were exactly equal to the standard, there is a 90% probability that the actual concentration would be below the criteria, and a 10% chance that the actual concentration would exceed the criteria. Where the 90th percentile model prediction exceeds the standard, additional mitigation would be required to demonstrate that the project would not cause a violation of water quality standards. This approach is consistent with the policy applied at the Idaho Cobalt Project (USFS 2009)—a recent NEPA-driven EIS for a hard rock mine where water quality effects were also estimated using a probabilistic model. The overall analysis of project impacts on water quality will also take into consideration the extent to which projected water quality compares against existing or "no-action" alternative conditions (which are the same for this project).

The state will retain the flexibility to modify this impact criteria based on consideration of low flow modeling analyses (e.g., under the 7-day, 10-year [7Q10] low flow scenario, which is the statistical flow basis upon which water quality effluent permit limitations are calculated), and on site-specific factors and model predictions (e.g., the 'shape' of the actual probability distribution for particular solutes; whether engineering controls are proposed in case predicted low probability concentrations would occur), with consideration of applicable permitting regulations and guidance.

2. Presentation of Model Results in the SDEIS

The SDEIS will not focus solely on improbably high pollutant concentrations, and instead take advantage of the full probabilistic output to provide the public with a realistic assessment of uncertainty. The Idaho Cobalt Mine EIS used a reasonable approach, presenting the 10th percentile, 50th percentile (the median value), and 90th percentile values for predicted solute concentrations.

3. Model Timestep and Presentation of Model Results

The GoldSim model will predict surface and ground water quality at each Point of Evaluation for each solute (and a few other water quality parameters) on a monthly basis for 200 years. The models operate by selecting from the possible ranges a single set of parameters that describe pollutant release and transport, and then use these parameters to calculate solute concentrations for the next 200 years. Ranges in predictions are generated by repeating this selection and prediction process many (e.g., one thousand) times.

The Co-lead Agencies and the third-party contractor will work with PolyMet to present the data in a user-friendly manner and without losing significant detail. Model results will be grouped for presentation into the three project phases: operations, closure, and post-closure. The solutes that will be modeled using probabilistic methods include: alkalinity, aluminum, arsenic, boron, barium, beryllium, calcium, cadmium, chloride, cobalt, chromium, copper, fluoride, iron, potassium, magnesium, manganese, sodium, nickel, lead, antimony, selenium, silver, sulfate, thallium, vanadium, and zinc.

4. Relationship of Recommended Impact Criteria with Required Mitigation

As indicated in Point 1 above, we recommend that the NorthMet Project be required to demonstrate with a 90% probability the ability to comply with state water quality standards. Mitigation (e.g., seepage capture wells at the Tailings Basin) will likely be required for at least some solutes at some evaluation locations to achieve 90% probability of complying with applicable water quality standards. The SDEIS will identify potential mitigation option(s) that are available to achieve the desired 90% predictive probability, but to defer a determination on the implementation of such mitigation to the permitting process so as to avoid incorporation of unnecessary mitigation into the project as initially constructed.

This determination by the permitting agency will be based on several factors, such as the ability for PolyMet to effectively monitor in a predictive manner for the identified parameter as well as the ability for PolyMet to implement necessary mitigation in a timeframe that would avoid a violation of applicable permit conditions or water quality standards. To the extent that the determination by the permitting agency indicates that PolyMet is not likely to be able to react in time during operations to avoid a violation of applicable permit conditions or water quality standards, then it is expected that the permitting agency would be required at project initiation mitigation necessary to achieve the 90% predictive probability. The Co-Lead Agencies will require water quality monitoring to confirm the GoldSim predictions. If the monitoring indicates that the modeling under-predicted actual solute concentrations, then MPCA retains the authority to require PolyMet to implement additional mitigation beyond that considered in the EIS in order to assure compliance with applicable water quality standards.

IAP Impact Criteria Process

- Interpreting Probabilistic Modeling Results
  - 90th percentile model concentration must be below applicable WQ Standard at evaluation point
  - Overall analysis will consider how model result compares to existing or 'no-action' conditions
  - The State maintains the flexibility to modify the impact criteria based on parameter-specific and site-specific analysis

- **Impact Criteria**

- For interpreting model results, the NorthMet project will be assumed to predict a
- significant effect on water quality if the 90th-percentile model concentration of a solute
- exceeds the State of Minnesota surface or ground water quality at an evaluation point.
- Thus if the modeled 90th percentile value were exactly equal to the standard, there is a
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- effects were also estimated using a probabilistic model. The overall analysis of project
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- water quality compares against existing or "no-action" alternative conditions (which are
- the same for this project).

- The state will retain the flexibility to modify this impact criteria based on consideration
- of low flow modeling analyses (e.g., under the 7-day, 10-year [7Q10] low flow scenario,
- which is the statistical flow basis upon which water quality effluent permit limitations
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- are proposed in case predicted low probability concentrations would occur), with
- consideration of applicable permitting regulations and guidance.

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- consideration of applicable permitting regulations and guidance.

Protecting Existing Surface Water Quality

- Process to evaluate potential impacts to surface water from project
- If impacts are predicted, considerations and steps to determine appropriate permit limits and restrictions consistent with Minnesota Rules and Clean Water Act
- Rely on available tools and experience to assess impacts and inform permitting decisions
- Minimal experience evaluating and permitting groundwater influences on surface water

What is Existing Surface Water Quality?

- Parameter specific determination
- Standards designed to protect to a given critical flow (e.g., 7Q10)
- Ideally concentration data collected during flow conditions would represent existing surface water quality
- Compare predicting model results to existing surface water quality to assess potential impacts

What are Potential Impacts?

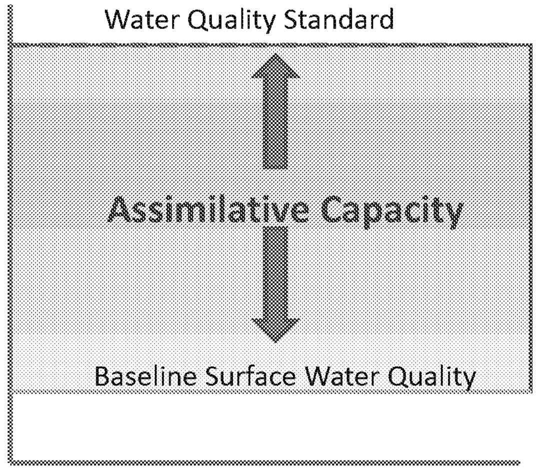
- Use probabilistic model results to forecast if project will result in a measurable impact on surface water quality
- How to define "measurable impact"
- Parameters to be considered in the comparison between the model and existing
- What happens when comparison shows a measurable difference?

Avoiding/Minimizing Impacts

- If results show project will use up some existing assimilative capacity
- Work with proposer to understand if impacts can be avoided? If not, can impacts be minimized?
- Goal is to avoid impacts and to minimize impacts to fullest extent practical when they cannot be avoided
- If water is impaired (above the water quality standard) the discharge cannot result in an increase in the concentration in the receiving water

Justifying use of Assimilative Capacity

- Require proposer to minimize impacts to fullest extent practicable
- What is the fullest extent practicable?
- The least amount of assimilative capacity justified by economic and social development impacts of the project



Tribal Standards

- Location of Potentially Affected Tribes
  - Grand Portage
    - Mouth of St. Louis River approx. 165 river miles downstream of Plant Site and 185 river miles downstream of Mine Site
    - Approx. 120 to 150 miles up the North Shore of Lake Superior from mouth of St. Louis River
  - Fond du Lac
    - Approx. 105 river miles downstream of Plant Site and 125 river miles downstream of Mine Site
  - Bois Forte (no Tribal WQS)
    - Not in Lake Superior Basin

Location of Fond du Lac Reservation